CLAIMS

1. A running aid comprising

a harness attached to a runner's body,

one or more brace legs extending from said harness to the ground, wherein said brace leg supports a runner's weight while walking and running, wherein the runner can be a human or a robot,

one or more hip pivots for rotatable connection of said harness with said brace leg, and

one or more asymmetric-travel brace feet, called brace feet herein, attached to the bottom of said brace leg, wherein said brace foot is sufficiently long to provide the comparable brace length asymmetry to said running brace as pertains to the length asymmetry of said runner, wherein the distance between the hip joint and the heel of said runner at the beginning of heel strike is less than the distance between the hip joint and the toe of said runner at toe-off when his foot leaves the ground, and

one or more foot couplings for attaching said runner's foot with said brace foot, wherein said running aid must be shaped and positioned so as to not interfere with the running action of said runner, wherein the elements of said running aid must extend around said runner's leg and foot.

2. The running aid of claim 1 wherein said brace leg comprises a spring mechanism for storage and return of running impact energy and a guide to resist the non-axial load of the impact force of said runner on said spring mechanism, wherein said spring mechanism connects in series with an upper pylon and a lower pylon of said brace leg.

3. The running aid of claim 2 wherein said spring mechanism comprises a series buckling-bow spring further comprising:

a top bow holder,

a bottom bow holder,

one or more mini-bows hingeably interconnecting said top bowholder to said bottom bowholder, wherein said top bow holder and said bottom bow holder make a rigid series connection with said upper pylon and said lower pylon, wherein said mini-bows are confined by said top and bottom bow holders so as to resist in parallel the compression of said top and bottom bow holders together, wherein said mini-bows are almost straight when not compressed to provide a buckling force curve when loaded, in which case their force curve is approximately a buckling load curve and is approximately constant as said mini-bows deflect under compression.

4. The running aid of claim 2 wherein said spring mechanism comprises a

perpendicular-series buckling-bow spring further comprising:

a top bow holder,

a bottom bow holder,

one or more bow stacks each comprising one or more mini-bows aligned parallel to each other, wherein at least one pair of said bow stacks is oriented substantially orthogonal to at least one other said bow stack, wherein said top bow holder and said bottom bow holder make a rigid series connection with said upper pylon and said lower pylon, wherein said mini-bows are confined by said top and bottom bow holders so as to resist in parallel the compression of said top and bottom bow holders, wherein said mini-bows hingeably connect said top bowholder to said bottom bowholder, wherein said mini-bows are almost straight when not compressed to provide a buckling force curve when loaded, in which case their force curve is approximately a buckling load curve and is approximately constant as said mini-bows deflect under compression, wherein orthogonal orientation of one said bow stack with another provides a resistance to torque accompanying non-axial loading of said perpendicular buckling-bow spring and resultant tilting of said upper pylon with respect to said lower pylon, wherein said perpendicular buckling-bow spring also functions as said guide.

5. The running aid of claim 2 wherein said guide comprises a hip link rotatably connected to said hip pivot and a thigh link element slidingly connected with said hip link and rotatably connected with said knee pivot, wherein said spring mechanism comprises a pulley bucky-bow spring comprising:

a bow spring,

a bow pulley block,

a bow guide rigidly attached to said bow pulley block and slidingly connected to the center region of said bow spring,

a bow pulley system comprising one or more pulleys,

bow strings which are connected to either end of said bow spring and which pass around one or more pulleys in said pulley system,

a draw string catch, and

a draw string which is attached at one end to said draw string catch and which passes around one or more pulleys in said pulley system and which transmits the force of said bow spring to resist the sliding of said hip link with respect to said thigh link element, wherein said bow strings extend from either end of said bow spring inward toward each other and then around said pulley system so that the turning of one or more pulleys in said pulley system causes the ends of said bow spring to be pulled together, wherein said bow guide prevents said bow spring from

rotating around said pulley block in the sense that an imaginary line connecting said bow ends does not rotate about said pulley block, wherein said bow spring may be almost straight when uncompressed to provide a buckling force curve when loaded, in which case the force curve is approximately constant as said bow spring is compressed.

6. The running aid of claim 5 wherein said pulley system comprises an inner pulley and an outer pulley for creating a mechanical advantage between the relative travel of said bow strings and said draw string, wherein the compression and force of said brace leg can be varied for a given compression of said bow spring.

7. The running aid of claim 6 wherein said harness further comprises a hip rim encircling said runner and a back support extending up and behind said runner's back, wherein said bow pulley block is rigidly attached to said back support, wherein said pulley system allows a single said bow spring to support one or both said brace legs during foot stance, wherein said pulley system further comprises a transfer system of pulleys to route said draw string from said bow pulley block to engage both of said thigh link elements at foot strike.

8. The running aid of claim 2 wherein said spring mechanism comprises a constant-force gas spring which comprises:

a gas spring,

gas tubes,

a gas reservoir connected to said gas spring by said gas tubes, and

a check valve, wherein the gas in said gas spring and said gas reservoir is pre-pressurized, wherein the ratio of volume of gas in said reservoir to volume in said gas spring is sufficiently high so that the pressure in said gas spring does not change substantially as said gas spring is compressed, wherein the force curve of said constant-force gas spring is substantially constant over its range of compression.

9. The running aid of claim 8 wherein said constant-force spring system further comprises a gas pump for replenishing pressurized gas in said gas spring lost during strokes of said gas spring.

10. The running aid of claim 2 wherein said brace leg comprises an active power source which acts in series with said spring system to impart thrust to said runner, wherein the force imparted by said active power source compresses said spring system which then thrusts with the combined energy from said active power source and impact energy stored in said spring system during impact of said runner's foot with the ground.

11. The running aid of claim 1 wherein said brace leg comprises a swing-

phase length-change means to shorten the length of said brace leg during swing phase and a length-change lock to prevent any change of the length of said brace leg during stance.

12. The running aid of claim 11 wherein said length-change lock comprises a means for guaranteed release of said length-change lock at toe-off.

13. The running aid of claim 12 wherein said swing-phase length-change means comprises

a thigh-link rotatably coupled with said harness,

a knee pivot rotatably attached to said thigh-link and which further comprises a knee pivot lock corresponding to said length-change lock,

a tibia link rotatably attached to said knee pivot, wherein the engagement of said pivot lock prevents said tibia link from rotating about said knee pivot with respect to said thigh-link assembly during the foot-stance phase portion of a stride cycle, wherein the disengagement of said pivot lock allows said tibia link to rotate freely about said knee pivot with respect to said thigh-link assembly during the swing phase portion of a stride cycle, wherein said tibia link is rotatably attached to said brace foot.

14. The running aid of claim 13 wherein said knee pivot lock comprises a hyper-extended knee lock which further comprises:

a knee pivot block,

a thigh-link constraint at the bottom end of said thigh link, and

a tibia-link constraint at the top end of said tibia link, wherein

said thigh-link constraint impinges against said tibia link constraint during the foot stance period when said brace foot is in contact with the ground, thereby ensuring that the structural support comprising said thigh link, said knee pivot lock and said tibia link is rigid, wherein said rigid state is called hyper-extension.

15. The running aid of claim 14 wherein said wherein said means for guaranteed release and said foot coupling comprise a heel pivot rotatably attached to the back of the foot of said runner and to the bottom of said tibia link, wherein the rearward location of said heel pivot ensures that said tibia link and said thigh link rotate freely so as to move said thigh link constraint away from said tibia link constraint when the foot of said runner lifts said heel pivot.

16. The running aid of claim 14 wherein said means for guaranteed release comprises a knee tether connecting said knee pivot with the knee of said runner.

17. The running aid of claim 14 wherein said tibia link comprises a four-bar foot-lift assembly comprising:

a thigh-link extension rigidly extending downward from said thigh link,

a foot-lift link hingeably connected to said thigh-link extension,

a toe pivot at the front of said brace foot wherein said foot-lift link is hingeably connect to said brace foot via said toe pivot,

an ankle pivot located at the ankle of said brace foot,

a thigh-link-extension front constraint rigidly attached to and extending forward from the bottom of said thigh-link extension,

a foot-lift-link front constraint rigidly attached to and extending forward from the top of said foot-lift link, wherein said thigh-link-extension front constraint impinges said foot-lift-link front constraint to limit the hyper-extension of said foot-lift link with respect to said thigh-link extension at heel-down, wherein the rearward location of said heel pivot ensures that said foot-lift link and said thigh-link extension rotate freely so as to move said thigh-link-extension front constraint away from said foot-lift-link front constraint at toe-off, wherein said foot-lift link lifts the front of said brace foot via said front pivot during swing phase thereby preventing downward motion of the front of said brace foot during swing phase.

18. The running aid of claim 14 wherein said hyper-extended knee lock comprises a four-bar knee joint which comprises four bars hingeably interconnected and one side of which is fixably attached to one said bar and another side of which is fixably attached to another said bar.

19. The running aid of claim 14 wherein said hyper-extended knee lock comprises a hyperlocker to ensure hyper-extension before foot strike.

20. The running aid of claim 19 wherein said knee pivot self lock comprises a knee-lock hyper-extension means called a hyperlocker, wherein said hyperlocker accelerates the extension unfolding of said thigh link and said tibia link about said knee pivot to ensure that said knee pivot self lock is hyper-extended at heel-strike, wherein said hyperlocker comprises

a rim beam pulley rigidly attached to said harness,

a thigh-link pulley attached to said thigh-link,

a slide-pulley cord attached to said rim beam, wherein the forward swinging of said thigh link causes the upward pulling on said slide-pulley cord through said thigh-link pulley,

a hyper-extension means keyed to the upward pull on said slide-pulley cord, wherein said tibia link is forced to hyper-extend about said knee pivot (with respect to said thigh link) during the latter part of swing phase, wherein said tibia link can be freely folded by the upward force of said runner's foot on said brace foot at toe-off.

21. The running aid of claim 19 wherein said hyperlocker comprises a self-

hyperlocker further comprising

a closer cord,

a cord-path system which routes said closer cord through a path along both the back side and the front side of said thigh and tibia links about said knee pivot, wherein said closer cord is fixed at a first end to said brace leg, wherein the cord-path length on the back side of said knee pivot increases more rapidly than the cord-path length on the front side of said knee pivot during said extension unfolding,

a closing spring located on the front side of said brace leg so as to pull into hyper-extension said thigh and tibia links when engaged,

a spring release connected to said brace leg and to a second end of said closer cord, and

a pawl system, wherein the configuration of said cord-path system causes said closer cord to pull taut at a particular flexion angle, of said thigh link with respect to said tibia link, as said brace leg extends during swing phase -- causing said closer cord to pull against said closing spring accelerating said extension unfolding, wherein said spring release is triggered to release said closing spring from acting against said closer cord as hyper-extension occurs, thereby allowing easy and force-free folding of said tibia link with respect to said thigh link at toe-off, and

a reset spring for re-engaging said closer cord with said closing spring during swing phase when said closer cord becomes slack, wherein said self hyperlocker is keyed to said flexion angle for guaranteed hyper-extension using said closing spring, and it is keyed to said hyper-extension for guaranteed release of said closing spring as folding begins.

22. The running aid of claim 14 wherein said knee pivot lock further comprises a "hyper-extension bounce back" prevention means to prevent the impact force of the closing of said knee pivot from causing said brace leg to bounce back out of hyper-extension wherein said "hyper-extension bounce back" prevention means also comprises

a bladder step, in the impinging surface of said tibia link that contacts said thigh link during said hyper-extension, wherein said bladder step forms a recessed region between said impinging surface and said thigh link when they are aligned,

a pinched bladder attached to said bladder step, filled with fluid, and protruding above the level said impinging surface,

a pinch band, and

an elastomer nipple, wherein said pinched band constricts said pinched bladder to form said elastomer nipple and to form an orifice between said

elastomer nipple and said pinched bladder, wherein said elastomer nipple lies outside of said bladder step, wherein said fluid is free to flow through said orifice from said pinched bladder to said elastomer when said hyper-extension occurs -- and during swing phase, wherein the restricted flow of said fluid through said orifice dissipates said impact force of closing .

23. The running aid of claim 12 wherein said knee pivot lock comprises a variable-angle knee lock comprising:

a shaft,

shaft spacers,

a shaft boss rigidly attached to and subtending a shaft locking angular range of said shaft, wherein said shaft boss further comprises a plurality of shaft circumferential strips rigidly attached to said shaft boss by a boss attachment structure, wherein said shaft circumferential strips are spaced apart one from another by said shaft spacers, wherein said shaft circumferential strips extend in the shaft longitudinal direction from their attachment location,

collar spacers,

a split-collar encircling said locking shaft wherein said split-collar further comprises a bearing collar section and a locking collar section, wherein said locking collar section further comprises a plurality of collar circumferential strips rigidly attached to said locking collar section by a collar attachment structure, wherein said collar circumferential strips are spaced apart one from another by said collar spacers, wherein said collar circumferential strips extend in the shaft longitudinal direction from their attachment location, wherein said bearing collar section forms a bearing surface with the portion of said shaft not subtended by said shaft locking angular range thereby allowing free pivoting of said split-collar about said shaft when said bearing surface is loaded, wherein said locking collar section subtends a collar locking angular range, wherein said shaft circumferential strips interleaf with said collar circumferential strips over an overlap longitudinal region, wherein said locking collar section has a collar recess for allowing said locking collar section to freely impinge said collar circumferential strips and said bearing circumferential strips at said longitudinal region without constraint by said boss attachment structure, wherein the radial extent of the inner portion of said shaft boss is sufficient to allow said locking collar section to freely impinge said collar circumferential strips and said bearing circumferential strips at said overlap longitudinal region without constraint by said collar attachment structure, wherein said locking collar section forms a locking surface with the portion of said shaft subtended by said shaft locking angular range thereby ensuring locking of rotation

of said split-collar about said shaft when said locking surface is loaded.

24. The running aid of claim 23 wherein said tibia link comprises

an upper-tibia link hingeably connected to said knee pivot,

a lower-tibia link hingeably connected with said ankle pivot,

a tibia pivot for hingeably connecting said upper-tibia link with said lower-tibia link,

a lower-tibia-link front constraint rigidly attached to and extending forward from the top of said lower-tibia link,

an upper-tibia-link front constraint rigidly attached to and extending forward from the bottom of said upper-tibia link, wherein said upper-tibia-link front constraint impinges said lower-tibia-link front constraint to limit the hyper-extension of said lower-tibia link with respect to said upper-tibia link at heel-down, wherein the rearward location of said heel pivot ensures that said tibia link and said thigh link rotate freely so as to move said lower-tibia-link front constraint away from said upper-tibia-link front constraint at toe-off, wherein any residual loading of said variable-angle knee lock at toe-off is released due to the folding of said upper-tibia link with respect to said lower-tibia link,

a lower-tibia-link rear constraint rigidly attached to and extending backward from the top of said lower-tibia link,

an upper-tibia-link rear constraint rigidly attached to and extending rearward from the bottom of said upper-tibia link, wherein said upper-tibia-link rear constraint impinges said lower-tibia-link front constraint to limit the folding of said lower-tibia link with respect to said upper-tibia link during swing phase, and

a closing mechanism to ensure that said lower-tibia-link front constraint impinges against said upper-tibia-link front constraint at heel-down, thereby ensuring that the structural support comprising said upper-thigh link, said tibia pivot and said lower-tibia link is rigid during stance phase.

25. The running aid of claim 12 wherein said swing-phase length-change means comprises a lockable slider comprising

a guide means comprising an upper and lower guide slidably interconnected, wherein said guide means is a series component of said brace leg,

a slider lock corresponding to said length-change lock, and

a slider-lock trigger, wherein ground contact of said brace foot causes said slider lock to lock said lockable slider, wherein said lockable slider is a series component of either said thigh link or said tibia link.

26. The running aid of claim 25 wherein said knee pivot lock comprises a lockable hydraulic slider comprising

one or more hydraulic cylinders containing fluid and a fluid line,

one or more hydraulic pistons which slide within said hydraulic cylinders moving said fluid through said fluid line,

a reservoir connecting said fluid line to said reservoir via an exit branch and a return branch,

a triggered valve system which prevents or restricts said fluid from exiting said hydraulic cylinder during stance, thereby locking said lockable hydraulic slider, and which allows said fluid to freely exit and enter said hydraulic cylinder during swing phase, thereby allowing free compression and expansion of said lockable hydraulic slider, wherein said lockable hydraulic slider is rotatably attached to both thigh link and said tibia link, wherein the locking of said lockable hydraulic slider locks said knee pivot lock.

27. The running aid of claim25 wherein said lockable slider comprises a lockable hydraulic slider comprising

one or more hydraulic cylinders containing fluid and a fluid line,

one or more hydraulic pistons which slide within said hydraulic cylinders moving said fluid through said fluid line,

a reservoir connecting said fluid line to said reservoir via an exit branch and a return branch,

a triggered valve system which prevents or restricts said fluid from exiting said hydraulic cylinder during stance, thereby locking said lockable hydraulic slider, and which allows said fluid to freely exit and enter said hydraulic cylinder during swing phase, thereby allowing free compression and expansion of said lockable hydraulic slider.

28. The running aid of claim 12 wherein said swing-phase length-change means comprises a lockable slider comprising

a guide means comprising an upper and lower guide slidably interconnected, wherein said guide means is a series component of said brace leg,

a slider lock corresponding to said length-change lock, and

a slider-lock trigger, wherein ground contact of said brace foot causes said slider lock to lock said lockable slider.

29. The running aid of claim28 wherein said lockable slider comprises a lockable hydraulic slider comprising

one or more hydraulic cylinders containing fluid and a fluid line,

one or more hydraulic pistons which slide within said hydraulic cylinders moving said fluid through said fluid line,

a reservoir connecting said fluid line to said reservoir via an exit branch and a

return branch,

a triggered valve system which prevents or restricts said fluid from exiting said hydraulic cylinder during stance, thereby locking said lockable hydraulic slider, and which allows said fluid to freely exit and enter said hydraulic cylinder during swing phase, thereby allowing free compression and expansion of said lockable hydraulic slider.

30. The running aid of claim 1 wherein said brace leg comprises a front/back brace leg further comprising

a front hip pivot,

a back hip pivot,

a front thigh link pivotly attached to the front of said harness with said front hip pivot,

a back thigh link pivotly attached to the front of said harness with said back hip pivot,

an optional front bow attached to said front thigh link,

a optional back bow attached to said back thigh link,

a front tibia link pivotly attached to the front of said brace foot,

a back tibia link pivotly attached to the back of said brace foot,

a front knee pivot connecting said front thigh link and said front tibia link,

a back knee pivot connecting said back thigh link and said back tibia link,

one or more hyper-extending knee pivot locks at the locations of said front and back knee pivots to prevent pivot hyper-extension,

an optional back hydraulic knee lock pivotly attached to said back thigh link and said back tibia link,

an optional front hydraulic knee lock pivotly attached to said front thigh link and said front tibia link,

a front ankle pivot for the connection of said front tibia link to said brace foot,

a back ankle pivot for the connection of said back tibia link to said brace foot,

a knee cross link connecting said front knee pivot with said back knee pivot, wherein said front and back hip pivots are located approximately above the center of each leg, wherein the front and back locations of said brace leg elements prevents interference with said runner's legs.

31. The running brace of claim 30 wherein said harness comprises a front/back pack extension further comprising

a front pack-frame pivot at the front of said harness,

a back pack-frame pivot at the back of said harness,

a front pack frame attached to the front of said harness via said front pack-

frame pivot,

a back pack frame attached to the back of said harness via said back pack-frame pivot,

pack straps,

a front pack secured to said front pack frame be said pack straps, and

back pack secured to said back pack frame be said pack straps, wherein said brace legs continuously support said front and back packs as said runner walks or runs.

32. The running aid of claim 1 wherein said brace foot comprises a curved surface on the bottom of said brace foot.

33. The running aid of claim 1 wherein said brace foot comprises one or more lockable hinged extensions in the front or back of said brace foot which can be locked for running or walking on relatively flat or shallow sloping terrain and which can be retracted for running or walking on steps or steep terrain.

34. The running aid of claim 28 wherein said slider-lock trigger comprises

an array of ground levers rotatably attached along the bottom of said brace foot,

a ground pulley, and

a ground trigger cord fixably interconnecting each said ground lever with its neighbor and passing around said ground pulley and up to said slider lock, wherein ground contact of any one of said ground levers causes said ground pulley to engage said slider lock.

35. The running aid of claim 12 wherein said means for guaranteed release comprises a foot-coupling guaranteed release which allows a runner's foot to freely move up at toe-off without lifting said brace foot for a prescribed time and distance and which ensures that said brace foot is lifted that same distance with respect to said runner's foot during swing phase, wherein any force between said runner's foot and said brace foot is zero for said prescribed time - allowing said length-change lock to release, wherein said brace foot is not allowed to hang below said runner's foot and trip said runner as said brace foot approaches heel-strike.

36. The energy-efficient running brace of claim 1 wherein said harness comprises:

a plurality of harness sections wherein some harness sections are upward-pull sections which naturally support an upward pull and some sections are downward-pull sections which naturally support a downward pull,

vertical connectors between said upward-pull sections and said downward-pull sections, and

a vertical tightening mechanism for cinching said upward-pull sections and said downward-pull sections against each other via said vertical connectors, wherein the compliance between said harness and said runner is reduced.

37. The running aid of claim 1 wherein said harness comprises a load-tightening mechanism to grip more tightly the body parts of a runner as the brace load of her weight between said support system and said harness increases, wherein the increased gripping force of the harness on said body parts is provided by said brace load, wherein a tightening distance is associated with said gripping and said tightening distance is the decrease in circumferential length of said harness due to said gripping.

38. The running aid of claim 37 wherein said load-tightening mechanism comprises one or more load-tightening cuffs encircling said body parts and a tightening mechanism to re-direct said brace load from an approximate vertical direction to an approximate horizontal direction to accomplish said gripping force to tighten said load-tightening cuffs.

39. The running aid of claim 37 wherein said load-tightening mechanism comprises a compressible woven harness, wherein said brace load pulls upward on the upper portion of said compressible woven harness causing said compressible woven harness to shrink in size, thereby increasing said gripping force, wherein said compressible woven harness comprises braids interwoven among themselves and extending along and around said body parts.

40. The running aid of claim 37 wherein said load-tightening mechanism comprises a mechanical-advantage mechanism wherein the distance or travel of the connection point between said brace leg and said harness is multiplied by a mechanical advantage to yield a greater value for said tightening distance, wherein the compliance between said brace leg and said harness under load is reduced by a factor approximately equal to said mechanical advantage.

41. The running aid of claim 1 wherein said harness comprises an arm-load harness to partially support said brace load with the arms of said runner.

42. The running aid of claim 1 wherein said harness comprises a load-equalizer means to distribute said brace load over all portions of said harness, wherein said load-equalizer means further comprises a system of pulleys and cables to evenly distribute said brace load over all portions of said harness.

43. The running aid of claim 1 wherein said harness comprises adjustable bands and fitting clamps wherein said adjustable bands are pulled through said fitting clamps and clamped to snugly fit said harness to said body parts.

44. The running aid of claim 38 wherein said tightening mechanism

comprises:

a spreader bar,

cuff buckles,

one or more tightening pulleys,

tightening cords, and

stay cords, wherein said load-tightening cuffs are attached on either end to said cuff buckles, wherein said spreader bar is mounted to said load-tightening cuff near an end, wherein said tightening pulleys are mounted to said spreader bar, wherein said stay cords are connected to said brace leg and transmit said brace load to tighten said tightening cuff by passing around said tightening pulleys which re-direct said brace load direction from a vertical to a horizontal direction, wherein said tightening cords also pass around said tightening pulleys and attach to said cuff buckles to transmit said brace load to pull together the ends of said tightening cuff, thereby tightening said tightening cuff.

45. The running aid of claim 25 wherein said tightening mechanism comprises:

a spreader bar,

cuff buckles,

one or more tightening levers,

tightening cords, and

stay cords, wherein said load-tightening cuffs are attached on either end to said cuff buckles, wherein said spreader bar is mounted to said load-tightening cuff near an end, wherein said tightening levers are mounted to said spreader bar, wherein said stay cords are connected to said brace leg and transmit said brace load to tighten said tightening cuff by pulling on first ends of said tightening levers to re-direct said brace load direction from a vertical to a horizontal direction, wherein said tightening cords are connected both to second ends of said tightening levers and also to said cuff buckles -- to transmit said brace load to pull together the ends of said tightening cuff, thereby tightening said tightening cuff.

46. The running aid of claim 39 wherein said compressible woven harness comprises combination mechanical/ weave load-tightener comprising:

stay cords,

pulley block attached to stay cords,

one or more block pulleys mounted on said pulley block,

top hoop sliding mounted to the top of said compressible woven harness,

bottom hoop sliding mounted to the bottom of said compressible woven harness,

vertical spreader bar mounted to said top hoop,

one or more spreader pulleys mounted to the bottom of said vertical spreader bar, and

cables, wherein said vertical spreader bar pulls upward on said compressible woven harness via said top hoop, wherein this upward pull is exerted by said cables which pass from said vertical spreader bar around said block pulleys and then down to pass around said spreader pulleys to pull down on bottom hoop, thereby spreading said compressible woven harness and causing it to circumferentially contract and grip said body parts.